Center for Research on Lifelong STEM Learning

BRINGING THE UNIVERSE TO AMERICA'S CLASSROOMS: OVERVIEW OF EVALUATION STUDY

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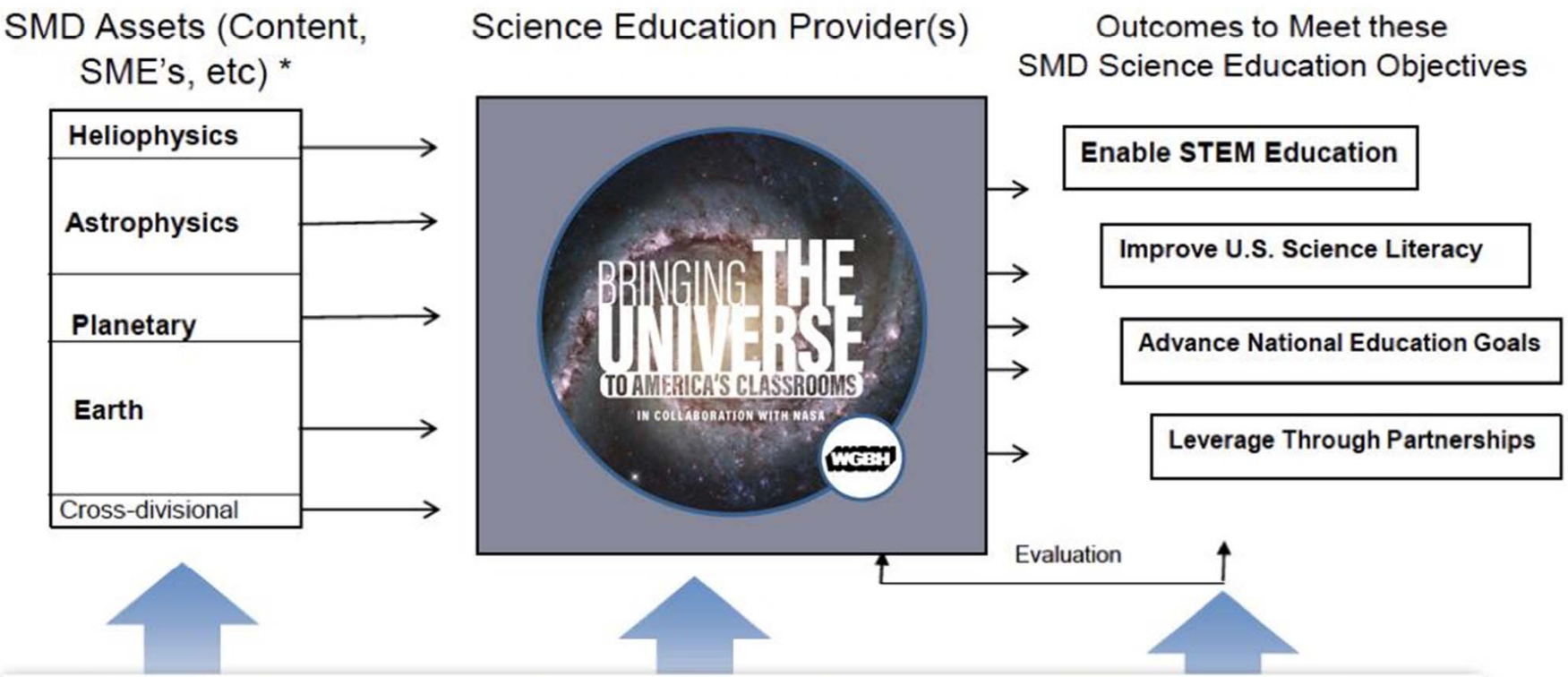
SMD Science Education Model



Meeting NASA's Science Education Objectives

NASA SMD Goals	WGBH Activities
Enable STEM Education	BUAC enables STEM education by **producing and distributing digital resources** that integrate NASA's unique assets into resources that **address targeted K-12 national science education standards** aligned with NASA SMD disciplines.
Improve U.S. Science Literacy	BUAC improves science literacy by engaging students with authentic **scientific practices** (e.g., analyzing and interpreting data) in the context of **disciplinary core ideas** through student-facing digital tools and media.
Advance National Education Goals 1. Improve STEM instruction 2. Better serve historically underrepresented groups	1. BUAC supports teachers in the curricular integration and implementation of digital-media resources with **professional development products and services**. 2. BUAC resources are designed for diverse learners, including accessibility features for **students with disabilities** and supports for **English Learners**.

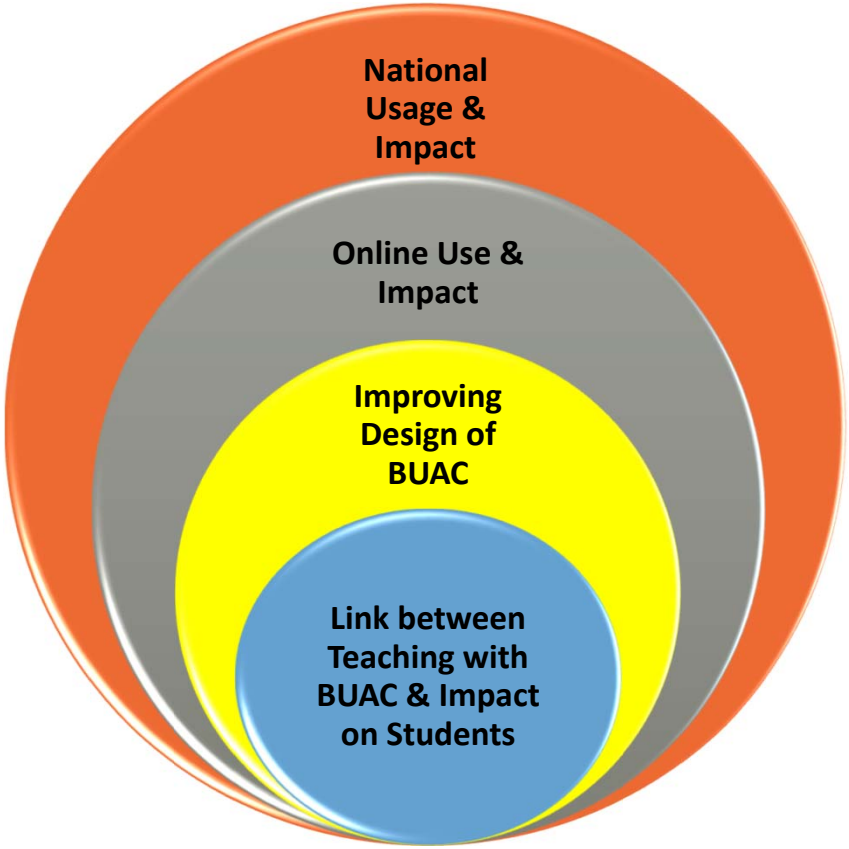
Overall Impact of BUAC = Impact on Students + Impact on Teachers

- On students: Average total unique student outcomes times estimated number of students served: $I_S = O_S * N_S$
- On teachers: Average total unique teacher outcomes times estimated number of teachers served: $I_T = O_T * N_T$
- For NASA: Degree to which top-level metrics of project success agreed upon between BUAC and NASA have been accomplished

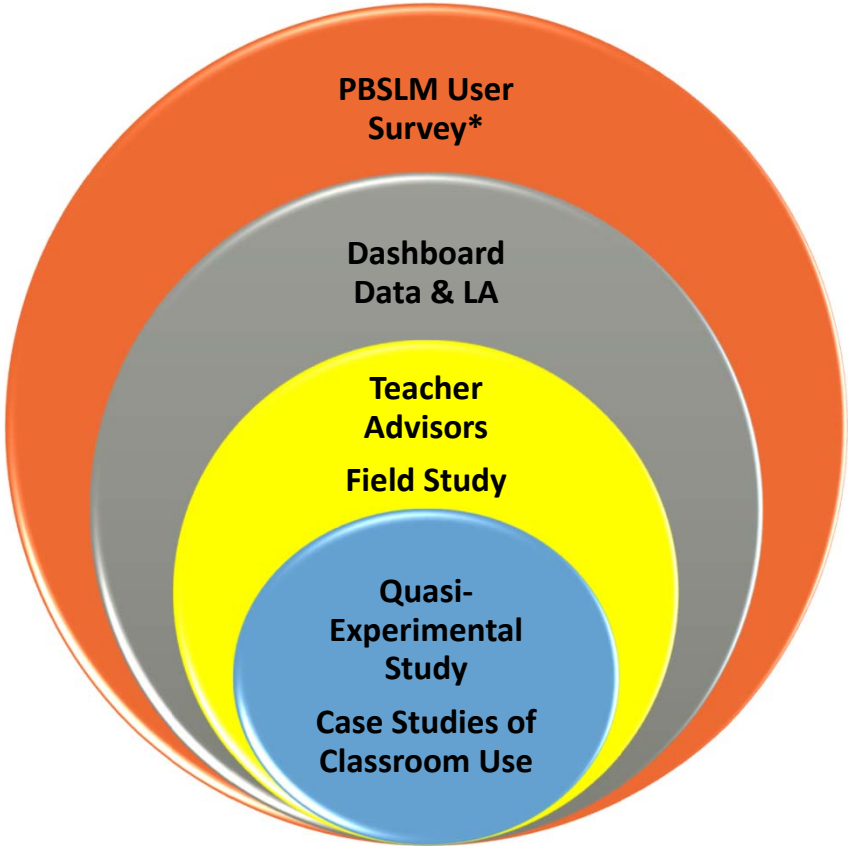
Overall Impact of BUAC = Impact on Students + Impact on Teachers

- Student outcomes: Experience engaging media-facilitated STEM lessons that support science literacy through multi-dimensional learning
- Teacher outcomes: Utilize NGSS-compatible trustworthy resources for quality media-based STEM instruction

Nested Study Design



Nested Study Design



Nested Study Design

Reach: Who was served? How many were served?

- BUAC usage metrics (Google analytics)
- BUAC and PBSLM* online survey (pending)

Behavior: What did those who were served do?

- BUAC Webpage survey
- Teacher Advisor Field Study
- Student embedded assessment aggregate data*

Outcomes: How were those who engaged with BUAC impacted?

- Teacher Field Study
- Resource usage
- Student embedded assessment aggregate data
- Classroom case studies (in-depth teacher feedback, observation)*
- Classroom-based quasi-experimental study*

Evaluation Study Progression

Year 1 Year 2 Year 3 Year 4
Year 5

Front-End and Formative >>> Formative & Summative >>>
Summative

Timeline for Study Design

Year 1:	National Science Teacher Needs Assessment (n= ~3,500)
	50 Teacher Advisors across U.S. to act as design testers
Year 2:	50 Teacher Advisors across U.S. to act as design testers
	Professional Development Needs Assessment with Teacher Advisors
Year 3-4:	National Field Study to Assess Naturalistic Usage (n=~350)
Year 4-5:	Quasi-Experimental Study to Assess Student Impact

Studying underlying claims

Reach: Who was served? How many were served?

- Survey of current PBSLM users (proxy for national scale survey - Year 5)*
- BUAC dashboard metrics and analytics*
- BUAC webpage survey*
- *Potential survey of outside partners (across all of SciAct?)*

Studying underlying claims

Behavior: What did those who were served do?

- BUAC dashboard metrics and analytics
- BUAC webpage survey
- Teacher field study
- Student embedded assessment aggregate data*
- [weak claim: “PBSLM survey”]

Studying underlying claims

Outcomes: How were those who engaged with BUAC impacted?

- BUAC webpage survey (self-report)
- Teacher field study (survey, interviews, focus groups = self-report)
- *Student embedded assessment aggregate data (behavioral and performance data)**
- Quasi-experimental study of classroom use with comparison group (observations, detailed teacher feedback, student embedded assessments, student survey)*

Studying National Reach

Survey of PBSLM / BUAC users* (proxy for all ”target” teachers), helps us understand:

- Reach: how many and who was engaged with BUAC?
- Estimate of BUAC use in classrooms (self-report)
- (Comparative) satisfaction with BUAC resources

Studying BUAC Module Pages

BUAC Module page analytics, helps us understand:

- Behaviors: *What did those who visited the BUAC website do?*

How?

- Dashboard metrics or analytics: behavior data on BUAC pages
- BUAC website survey: data on how teachers use the materials [Use website behavior as trigger for survey]

Field Study & Quasi-Experimental Study

The field study and quasi-experimental study help us understand:

- Translation into classroom
- Outcomes for students and teachers
- Field Study: teacher self report
- Quasi-Experimental: Assessment, observation

Teacher Field Study

- Allows us to translate: ”What do teachers do online” to “What teachers do in the classroom”
- Non-random sample, but bias can be estimated. High interest group (ideal scenario), but not necessarily high-capacity group (needs check)
- Estimate for upper limit of translation (at this time.
- Estimate for variation in implementation (fidelity?)
- Sample frame: teacher advisor applicants from Years 1-2: 600-700 teachers, sampling rate of 1/3 (aim for ~200 teachers)? Small incentive.
- N=~350, distributed across country

Teacher Field Study

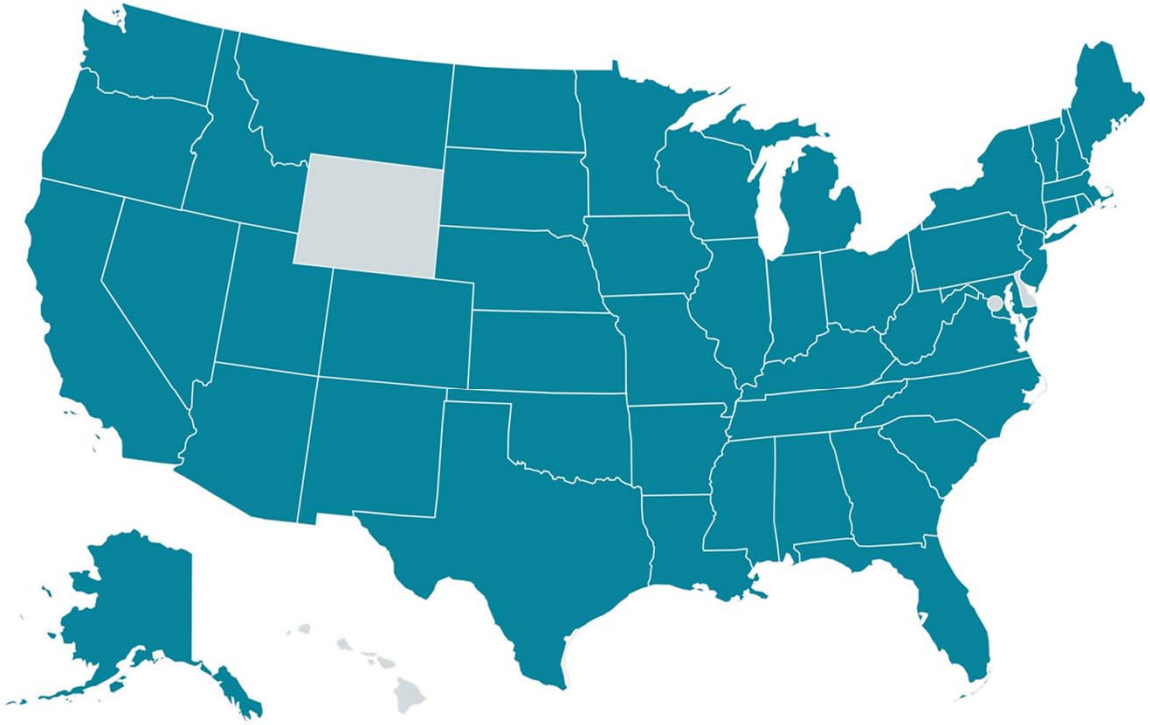
Methodology:

- Year-long field study (not an intervention)
  - Survey: What did they use? Who with? When did they use it? How did they use it? [monthly reminder to report out – simple interface]
  - Permission to track behavior: students and teachers logged on to PBSLM – link student performance on embedded assessment to teaching?

- Student Assessment:
  - Embedded assessments: teacher-created or WGBH module
  - Teacher (self)-report on student learning gains

- Teacher Assessment:
  - Insights on pedagogy (use of digital media, teaching with practices)

Teacher Field Study



345 teachers representing 47 states and Puerto Rico

Quasi-Experimental Study

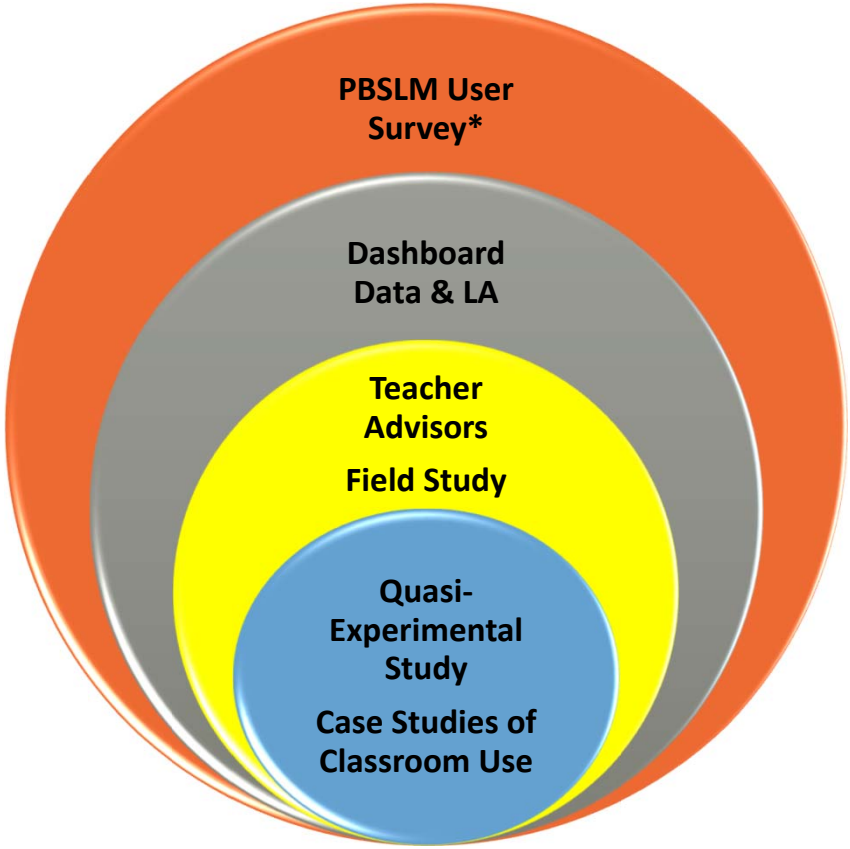
- Student-outcome focus: This allows us to make claims about student learning
- Limitation: it is an artificial set-up – does not allow us to support claims about average teacher behavior and student outcome, but…
- Case study of teachers (drawn from different pool than Teacher Advisors) with comparison group: can illustrate benefits and challenges
- Claims about impact at scale? Embed into nested other studies

Quasi-Experimental Study

Methodology:

- Classroom observation: indication of “fidelity” of implementation (independent variable)
- Use of highly-prescribed BUAC material; use of embedded assessments.
- May use two comparison groups: One to teach similar “curriculum” without extensive media use. One without directions [Needs further discussion – depends on claims]
- Pre-post assessments: student embedded assessments & affective outcome survey
- Teacher questionnaires and pre-post surveys: includes attitudes towards media as tools for teaching

Nested Study Design



Key Findings From Years 1 & 2

Digital Media Usage:

- Teachers value and comfortably use digital media in their classroom instruction.
- Teacher Advisors value trustworthy and high-quality resources from NASA, WGBH and PBS LearningMedia.
- Citing time and effort needed to find the aforementioned trustworthy and high-quality resources online, teachers value a trusted source curating a set of resources with supports to readily implement into their classrooms.
- Teachers currently use primarily images, videos and infographics.
- The teachers also noted constraints that they perceived could limit implementation in their classrooms: limited technology, lack of access for all students to technology at home, potential connectivity issues, and limited time.

Value of Digital Media

- Teacher Advisors in years 1 and 2 of the study indicated the following as advantages of using digital media resources for science instruction:
  - Digital media resources – especially animations and simulations – help students visualize abstract scientific concepts and brings the science concepts to life;
  - Digital media resources help students experience what they might not otherwise in their classroom (e.g., due to scale, proximity/location, lack of resources);
  - The digital media resources facilitate students' ability to relate science content to real-life (authentic science), especially as compared to what is typically presented in science textbooks.

Student Engagement with Science Concepts and Practices

- Teacher Advisors reported overwhelmingly that the Instructional Modules and their components assisted their students in learning science concepts. This was also evidenced during classroom observations conducted by the research team.
- Teacher Advisors saw their students engaging in the practices, especially o*btaining, evaluating and communicating information*, *analyzing and interpreting data*, *engaging in argument from evidence,* and *asking questions and defining problems.* Similarly, the research team observed students engaged with these practices during classroom visits, particularly *analyzing and interpreting data* and *obtaining, evaluating and communicating information.*

Key Findings from Years 1 & 2 Continued

Professional Development:

- Teachers regularly engage with PD, both on their own and as school and district mandated.
- Teachers report that the most effective PD experiences with which they have engaged have the following characteristics:
  - Hands-on and engaging, include watching demonstrations, learning by doing, and think-pair-sharing;
  - Targeted towards teachers' current instruction and aligned with standards (both NGSS and state-level);
  - Include materials teachers can bring back and implement in their classrooms;
  - Are research-based and provided by experts who can clearly communicate the design behind the instruction.
- While teachers value that synchronous PD opportunities allow them to communicate with other participants and solicit feedback from the instructors, many prefer self-paced or asynchronous PD opportunities that afford them flexibility to complete on their own time and adapt as needed.

Instructional Module/Resource Collections:

- Teachers value that digital media are provided in an instructional context and aligned with NGSS. They also valued that the resources were curated from trusted sources including both NASA and PBS Learning.
- Teachers value that the Instructional Modules are both readily implemented and flexible to adapt to individual teacher, student, and classroom needs. The teachers shared specific ways they were adapting and using the resources and this was corroborated through classroom observations.
- Teachers value both the teacher supports and the diverse learner supports, though they would still like to see greater supports (for example student handouts in multiple languages and supports for students reading below grade level). Teachers also reported difficulty navigating the PBS LearningMedia site and finding and connecting all supports with resources. They suggested greater guidance to more efficiently navigate the BUAC pages of PBSLM.
- Teachers seem to be unsure of the messaging and terminology utilized by BUAC around what is provided in the IMs. Many noted that the resources weren't packaged to be immediately implemented in their classrooms and several suggested implementation guidance including pacing guides, seeming to indicate that some teachers may believe BUAC is providing curriculum materials rather than supplements.
- According to classroom observations, the greatest influences on implementation in the classroom were technology challenges (e.g. videos not playing, students having difficulty navigating the interactive lessons) and the time that teachers took to engage with students. This often led to the lesson plan taking longer than the estimated time.